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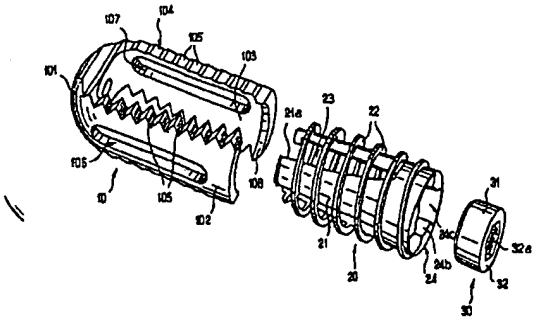


(57) Abstract

The invention concerns an implant for backbone surgery essentially comprising a hollow body (10) to be inserted in an intervertebral space, said body having a pair of lateral walls (102, 103) enclosing an internal space exposed to the superjacent and subjacent vertebrae defining said intervertebral space. The implant further comprises an anchoring reinforcement member (20) having on its outer surface bone anchoring projections (22) inscribed in a diameter greater than the body overall height, said member being driven in rotation in the inner space of the body. The invention concerns various improvements to such a two-part implant.

ABSTRACT

An implant for surgery of the spine comprises an essentially hollow body (10) which can be inserted into an intervertebral space, the said body having a pair of lateral walls (102, 103) enclosing an internal space exposed to the overlying and underlying vertebrae which define the said intervertebral space. The implant additionally comprises an anchorage reinforcement member (20) having, on its external surface, projections (22) for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said member being able to be driven in rotation in the internal space of the body.

The invention proposes various improvements to such an implant in two parts.

(Figure 16)

INTERSOMATIC IMPLANTS IN TWO PARTS

The present invention relates generally to intersomatic implants which can be used in the surgical treatment of the spine.

A great many intersomatic implants are already known.

These include, in particular, implants having a more or less complex structure, made up of several parts, particularly to give them certain deformability characteristics. These known implants have the disadvantage that they are more expensive and difficult to manufacture, and that they are more awkward to fit. They can also suffer from a problem of long-term reliability.

Implants are also known which, in order in particular to overcome all or some of the above disadvantages, being [sic] in the form of one-piece hollow bodies, or cages, provided with roughened areas on their upper and rear faces in order to ensure good initial immobilization relative to the overlying and underlying vertebral plateaus, their hollow character permitting bone to grow through them and, eventually, immobilize them definitively.

Document FR-A-2,703,580 describes an example of such an implant.

These known one-piece implants, despite the presence of roughened areas which become anchored in the vertebral plateaus when the intervertebral distraction necessary for fitting them is removed, may in some cases have inadequate stability, since the quality of the anchoring, which is effected by a simple translational movement, is dependent in particular on the hardness of the bones.

Document DE-U- also discloses an implant which includes an outer body into which an inner anchorage reinforcement element can be engaged by screwing, the threads of the anchorage reinforcement element

projecting above and below the upper and lower faces of this outer body.

It would be desirable to improve this type of known implant.

SUMMARY OF THE INVENTION

An implant for surgery of the spine comprises an essentially hollow body which can be inserted into an intervertebral space, the said body having a pair of lateral walls enclosing an internal space exposed to the overlying and underlying vertebrae which define the said intervertebral space. The implant additionally comprises an anchorage reinforcement member having, on its external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said member being able to be driven in rotation in the internal space of the body.

To counter the reverse movement of the said body out of the said intervertebral space, and hence to further improve the securing of the implant in position, the said hollow body may have upper and lower surfaces provided with sharp-edged teeth which can be anchored in the said vertebrae.

The said teeth preferably have a triangular cross-section.

In order to improve the compactness of the implant and to make it easier to put into place, the said lateral walls of the hollow body may be partially cylindrical and coaxial with an axis of the said anchorage reinforcement member.

In order to promote the growth of bone outside the implant, in particularly laterally, the said lateral walls may have through-openings permitting bone to grow through them.

These openings may advantageously comprise elongate slots extending essentially parallel to the direction of insertion of the said member into the said hollow body.

In order to give the body a greater width, it is possible to use, for the lateral walls of the body, thick walls in which second through-openings are formed, extending between the upper and lower faces of the body. Bone growth can also be induced between the two vertebral plateaus via these second through-openings.

The said first through-openings preferably bring the said internal space into communication with the said second through-openings.

It is also possible to provide through-openings which bring the said second through-openings into communication with the outer sides of the body.

The hollow body may have a distal end wall connecting the said lateral walls, this distal end wall being rounded to facilitate insertion of the said hollow body into the said intervertebral space.

The hollow body of the implant may have a distal end wall connecting the said lateral walls, and this distal end wall may have a tapped hole for temporarily fixing the said hollow body to an instrument for inserting the body, in order thereby to make it easier for the surgeon to put it into place.

The said projections for bone anchorage may comprise a self-tapping screw thread.

This thread can have a generally square radial cross-section.

This screw thread preferably has a radial cross-section which changes progressively from an essentially triangular radial cross-section to the said generally square radial cross-section starting from the distal end of the said thread, whilst the diameter of the screw thread increases progressively, starting from its distal end, up to a part of essentially constant diameter.

The projections of the implant for bone anchorage may comprise a screw thread in the form of a helical band encircling an internal space of the said anchorage reinforcement member.

This helical band may be advantageously connected to a fork extending inside the said band in an axial direction of the said member, and this fork preferably comprises two branches extending from a proximal end wall of the said anchorage reinforcement member.

The fork can also comprise branches having a frustoconical external surface, the diameter of which decreases from the proximal end towards the distal end of the member. This makes it possible to compress a substance promoting bone growth, placed beforehand in the anchorage reinforcement member, when the latter is being

screwed in.

Alternatively, the fork comprises at least two branches, each having a cutting edge for attacking the bone, in order thereby to accumulate bone chips inside the member 20 and facilitate bone fusion.

It is preferable for the fork and the helical band to be made in one piece.

The implant projections for bone anchorage may comprise a screw thread, and in which the said member has means for immobilising the latter against reverse rotation. These immobilising means preferably comprise a deformed part of the said thread in the region of its proximal end. This therefore improves the stability of the implant until fusion has taken place.

The projections for bone anchorage may comprise a screw thread having an external diameter which decreases, in its distal region, towards its distal end, in order to make it easier for this thread to penetrate the vertebral plateaus.

The anchorage reinforcement member may have a proximal end wall which is able to essentially close a frontal opening of the said hollow body in such a way that a substance promoting bone growth, placed inside the said member, is compressed during the insertion of the said member into the said hollow body.

In this case, the anchorage reinforcement member has at least one part whose external surface belongs to a truncated cone. Alternatively, the anchorage reinforcement member is substantially shorter than the body and has a generally conical point directed towards the said distal end wall of the body.

It is advantageous in this case that the proximal end wall of the member has a tapped opening for temporarily fixing the said member to an instrument for inserting the member.

The anchorage reinforcement member may have indexing means for fixing the said member, to an instrument for inserting the member, in a given angular relationship.

The anchorage reinforcement member may have a plug attached at its proximal end, which plug can, for example, be screwed into a tapped frontal opening of the anchorage reinforcement member, or else can be engaged by being

clipped elastically into a frontal opening of the anchorage reinforcement member.

It is advantageous that this plug has an arrangement which can cooperate with an instrument allowing the member to be driven in rotation, and/or arrangements for angular indexing of the anchorage reinforcement member with an instrument for positioning the said member.

One aspect of the present invention provides an implant for surgery of the spine, comprising an essentially hollow body which can be inserted into an intervertebral space, the said body having a pair of lateral walls enclosing an internal space exposed to the overlying and underlying vertebrae which define the said intervertebral space, the said implant additionally comprising an anchorage reinforcement member having, on its external surface projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said member being able to be driven in rotation in the internal space of the body, and in which the said projections for bone anchorage comprise a screw thread, and at least one of the lateral walls of the body has a reentrant part which is able to cooperate with the said thread.

This reentrant part can be provided only on one of the branches and can then constitute the only part of the body cooperating, by screwing, with the screw thread.

In addition, this reentrant part can have an essentially rectilinear free end edge.

The implant member may be oriented obliquely, for example, at about 45°, in relation to a plane of the body corresponding to the sagittal plane.

Through-openings may be provided in the said member between the interior and the exterior thereof, the said openings being elongate in an essentially circumferential direction of the member.

The body may have a distal end wall, and the anchorage reinforcement member has a distal end part which can be screwed into an opening of the said distal end wall.

The body can also in this case have a proximal end wall including an opening which is wider than the external dimension of the said anchorage reinforcement

member and in which the said member can be engaged freely.

The body may have a proximal wall, a distal wall and two lateral walls, the said walls defining between themselves an internal space which is larger than the said anchorage reinforcement member. This therefore increases the space designated for bone growth between the overlying and underlying vertebral plateaus.

In this case, the anchorage reinforcement member can have a threaded part for screwing it into the proximal wall of the body, or else the said anchorage reinforcement member and the distal wall of the body can have threaded means cooperating with each other for fixing the said member to the body.

In such a configuration, the projections for bone anchorage can comprise a screw thread having the same pitch as the said threaded part or the threaded means for fixing to the body.

The shape of the body, in this case, is preferably such that the lateral walls and the proximal wall of the body extend essentially on the same arc of a circle, and that the said distal wall is essentially rectilinear.

It is also advantageous that the upper and lower faces of the body have projections for bone anchorage which extend along its walls.

The implant may be provided with means for mounting the anchorage reinforcement member so that it can rotate in the internal space of the body, while at the same time preventing a relative translational movement between these.

These mounting means advantageously comprise a cylindrical opening formed in a distal end wall of the said body, and a shaft provided on the said member and able to be engaged, by elastic deformation, in the said opening.

In this particular case, the said anchorage reinforcement member preferably has the shape of a screw having two diametrically opposite flats, the said projections for bone anchorage being defined between the said flats, and cutting edges being provided at the transitions between the thread of the screw and the flats in order thereby to promote the bone fusion once the implant has been put into place.

To facilitate the insertion of the implant, the distance between the opposite flats is not greater than the distance between the upper and lower faces of the said body.

The implant may comprise an essentially hollow body which can be inserted into an intervertebral space, the said body having a group of generally parallel walls defining at least two internal spaces situated side by side and exposed to the overlying and underlying vertebrae which define the said intervertebral space, the said implant additionally comprising at least two anchorage reinforcement members having, on their external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said members being able to be driven in rotation in respective internal spaces of the said body.

The said members may advantageously be identical. The hollow body can have different geometries, and in particular:

- and lower surfaces which are inclined in relation to one another, with a distance between them which decreases from the proximal end towards the distal end of the body; and/or
- upper and lower surfaces which are inclined in relation to one another, with a distance between them which decreases from a first lateral side of the body towards the opposite lateral side.

A set of implants may be provided for forming a spinal implant intended to be inserted into an intervertebral space of the human vertebral column by being adapted to the geometry of the said intervertebral space. This set of implants may comprise:

a plurality of hollow bodies, each having a pair of lateral walls delimiting an internal space and each able to be inserted into an intervertebral space in such a way that the said internal space is exposed to the overlying and underlying vertebrae which define the said intervertebral space, each of the said bodies having a specific size and shape,

at least one anchorage reinforcement member having, on its external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the bodies, the said member being able to be driven in rotation in the internal space of any one of the said bodies,

in such a way that a specific hollow body appropriate to the particular configuration of a given intervertebral space can be chosen from among the said plurality of hollow bodies.

The specific sizes and shapes of the bodies can result in particular from:

- different angles of inclination between their upper and lower surfaces;
- different widths; in this case, the widest hollow bodies advantageously have lateral walls in which through-openings are formed which extend between the upper and lower faces of the said bodies;
- different heights;
- different lengths.

Preferably, a defined group of hollow bodies from the said plurality is able to receive a same type of anchorage reinforcement member.

Another aspect of the invention provides a method for positioning, in an intervertebral space of a human vertebral column, an implant comprising an essentially hollow body having a pair of lateral walls enclosing an internal space, and an anchorage reinforcement member having, on its external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, and able to be driven in rotation in the internal space of the body, the said method comprising the following steps:

selecting from a set of hollow bodies, which have different shapes and dimensions, a hollow body which is adapted to the configuration of the said intervertebral space;

filling the said selected hollow body with a substance which promotes bone growth;

pushing the said hollow body into the said intervertebral space in such a way that the internal space thereof is exposed to the overlying and

than the overall height of the bodies, the said member being able to be driven in rotation in the internal space of any one of the said bodies,

in such a way that a specific hollow body appropriate to the particular configuration of a given intervertebral space can be chosen from among the said plurality of hollow bodies.

The specific sizes and shapes of the bodies can result in particular from:

- different angles of inclination between their upper and lower surfaces;
- different widths; in this case, the widest hollow bodies advantageously have lateral walls in which through-openings are formed which extend between the upper and lower faces of the said bodies;
- different heights;
- different lengths.

Preferably, a defined group of hollow bodies from the said plurality is able to receive a same type of anchorage reinforcement member.

The invention finally proposes a method for positioning, in an intervertebral space of a human vertebral column, an implant comprising an essentially hollow body having a pair of lateral walls enclosing an internal space, and an anchorage reinforcement member having, on its external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, and able to be driven in rotation in the internal space of the body, the said method comprising the following steps:

selecting from a set of hollow bodies, which have different shapes and dimensions, a hollow body which is adapted to the configuration of the said intervertebral space;

filling the said selected hollow body with a substance which promotes bone growth;

pushing the said hollow body into the said intervertebral space in such a way that the internal space thereof is exposed to the overlying and

underlying vertebrae which define the said intervertebral space; and

inserting the said anchorage reinforcement member into the said hollow body in such a way that the said projections for bone anchorage anchor in the said overlying and underlying vertebrae.

In the case where the intention is to position an implant whose body has lateral walls provided with through-openings extending between the upper and lower faces of the said body, the method can additionally comprise, before the step of pushing the said hollow body into the said intervertebral space, a step in which the said through-openings are filled with a substance which promotes bone growth.

BRIEF DESCRIPTION OF THE DRAWINGS

Other aspects, aims and advantages of the present invention will become more apparent on reading the following detailed description of preferred embodiments thereof, given by way of example, and with reference being made to the attached drawings, in which:

Figure 1 is a perspective view of an implant according to a first embodiment of the invention,

Figure 2 is a side view of the implant from Figure 1, placed between two vertebral plateaus,

Figure 3 is a front view of the implant from Figure 1,

Figure 4 is a plan view of the implant from Figures 1 and 3,

Figure 5 is a side view of an element of the implant from Figure 1,

Figure 6 is an end view in the direction of arrow VI in Figure 5,

Figure 7 is an end view in the direction of arrow VII in Figure 5,

Figure 8 is a perspective view of the element from Figures 5 to 7,

Figure 9 is a perspective view of an implant according to a second embodiment of the invention,

Figure 10 is a front view of the implant from Figure 9,

Figure 11 is a plan view of the implant from Figures 9 and 10,

Figure 12 is a plan view of a first element of the implant from Figures 9 to 11,

Figure 13 is a side view of a second element of the implant from Figures 9 to 11,

Figure 14 is an end view in the direction of arrow XIV in Figure 13,

Figure 15 is an end view in the direction of arrow XV in Figure 13,

Figure 16 is an exploded perspective view of an implant according to a third embodiment of the invention,

Figure 17 is a side view of the implant from Figure 16, when assembled,

Figure 18 is a view in the direction of arrow XIIX [sic] in Figure 17,

Figure 19 is a view in the direction of arrow XIX in Figure 17,

Figure 20 is an exploded perspective view of an implant according to a fourth embodiment of the invention,

Figure 21 is a side view of the implant from Figure 20, when assembled,

Figure 22 is a view in the direction of arrow XXII in Figure 21,

Figure 23 is a view in the direction of arrow XXIII in Figure 21,

Figure 24 is an exploded perspective view of an implant according to a fifth embodiment of the invention,

Figure 25 is a side view of the implant from Figure 24, when assembled,

Figure 26 is a view in the direction of arrow XXVI in Figure 25,

Figure 27 is a view in the direction of arrow XXVII in Figure 25,

Figure 28 is an exploded perspective view of an implant according to a variant of the third embodiment of the invention,

Figure 29 is a perspective view of the implant from Figure 28, in the assembled state,

Figure 30 is a view of the rear of the implant from Figure 29,

Figure 31 is a side view of the implant from Figure 29,

Figure 32 is a plan view of the implant from Figure 29,

Figure 33 is a perspective view, before assembly, of an alternative design of the third embodiment of the invention,

Figures 34 to 36 are three perspective views of the body of this alternative design,

Figure 37 is an end view, from the distal direction, of this same body,

Figure 38 is a perspective view of the anchorage reinforcement member of this alternative design,

Figure 39 is a side elevation of this same anchorage reinforcement member,

Figures 40 and 41 are two perspective views of the implant according to this same alternative, in the assembled state,

Figure 42 is a plan view of this same implant when assembled,

Figure 43 is a side elevation of this same implant when assembled, and

Figure 44 is an end view, from the proximal direction, of this same implant when assembled.

DETAILED DESCRIPTION OF EMBODIMENTS

First, it will be noted that, from one figure to another, identical or similar elements or parts are

as far as possible designated by the same reference labels.

It will also be noted that the terms "proximal" and "distal" used throughout the present description correspond, respectively, to that end of the implant nearest the surgeon during the fitting operations, and that end of the implant furthest from the surgeon.

Referring first to Figures 1 to 8, a cage-type intersomatic implant is shown which is made up of two parts, namely a body 10 and an anchorage reinforcement member 20.

The body 10 has the general shape of a ring, with an upper face 11, a lower face 12, an inner face 13 and an outer face 14.

The contour of the body 10 has a circular shape truncated by a part of rectilinear contour, its width being equal, for example, to about four thirds of its depth.

Along the rectilinear contour part, on the upper and lower faces 11 and 12, roughened areas are formed to ensure that the implant is immobilized relative to the overlying V1 and underlying V2 vertebral plateaus (see Figure 2) when the implant is compressed between these.

These roughened areas are in this case in the form of three upper ribs 11b and three lower ribs 12b, of triangular cross-section and of circular trajectories concentric with the circular contour part of the body.

Opposite the rectilinear contour part, the body has a thicker wall, produced by an upper land 11a and a lower land (not labelled).

Formed in this wall part there is a tapped through-orifice 18 whose axis extends obliquely, and preferably at about 45°, relative to the vertical plane perpendicular to the plane distal wall of the implant, which vertical plane corresponds to the sagittal plane.

In addition, the axis of this orifice 18, which extends essentially horizontally, passes substantially

through the centre of the circular contour part, going towards the opposite region situated at the transition between the circular contour part and the rectilinear contour part.

The implant according to the invention additionally comprises a member 20 intended to reinforce the anchoring on the vertebral plateaus.

In this example, this member is in the form of a hollow cylindrical core 21, on the outer surface of which there is a helical thread 22 which is complementary to the internal thread formed in the orifice 18.

Formed between the adjacent thread sections there are a plurality of openings 23, oblong in the direction of the helical run of the thread, for reasons explained below.

At its distal end, the member 20 is closed by a solid wall 25. In the vicinity of its opposite face defining its proximal end, it includes a solid part 24 in which there is formed a hollow recess 24a, for example of hexagonal cross-section, for introduction of a screwing instrument (not shown).

It is important to note, as is shown in particular in Figure 3, that the overall diameter D within which the thread 22 of the member 20 is inscribed is slightly greater than the overall height H within which the body 10 is inscribed, this being for reasons which are explained below.

It will be observed here that the length of the member 20 is such that it can be screwed into the orifice 18 of the body 10 until the outer face of its proximal solid part 24 is substantially aligned with the outer face 14 of the body 10 adjoining the said orifice.

The use of an implant such as has been described above will now be explained. It will be observed that the same type of procedure, with the necessary adaptations, will be performed for the other

embodiments, described below, of the implants according to the invention.

Distraction having first been performed between two vertebrae to be treated, by means which are well known per se, the intervertebral disc is at least partially removed and the body 10 of the implant, without its member 20, is put into place, by an anterior or posterior approach. The internal space of the body is advantageously first filled with bone grafts in order to ensure eventual intervertebral fusion by osteogenesis.

It will be observed here that the contour of the body 10, with the flat in the proximal part, is such that it is easily inscribed within the surface area of a vertebral plateau. If necessary, it is possible to offer the surgeon different sizes of body 10, to be selected as a function of the spinal anatomy of the patient, as will be seen in greater detail below.

The two vertebrae are then released, and an initial immobilization of the body between the vertebral plateaus V1 and V2 is ensured with the aid of the ribs 11b, 12b.

The member 20 is then screwed into the orifice 18 with the aid of an instrument. During this movement, the crest of the thread 22, which projects slightly upwards and downwards in relation to the crest parts of the ribs 11b, 12b, cuts into the opposing faces of the overlying and underlying vertebral plateaus in the manner of a self-tapping screw, and thus affords a supplementary anchoring which will firmly immobilize the implant relative to these plateaus.

In addition, the rotation of the member 20 as it penetrates the internal space, filled with bone grafts, of the body 10 ensures that some of these grafts will migrate through the openings 23 and into the internal space of the hollow member 20. The bone growth will therefore also be obtained through the member 20, and this will advantageously immobilize the

member 20 in terms of any rotation, particularly reverse rotation, that risks affecting the stability of the implant in the long term. Alternatively, it is also possible for the member 20 to be filled beforehand with bone grafts.

Figures 9 to 15 illustrate a second embodiment of the present invention.

In these figures, elements or parts which are identical or similar to those in Figures 1 to 8 are designated by the same reference labels, and only the differences between this second embodiment and the first will be described.

It will first be noted that the body 10, which has the same contour as in the case of Figures 1 to 8, here has a wall of essentially constant thickness over its whole periphery.

Instead of the tapped orifice 18 in the first embodiment, this body includes a smooth through-orifice 19.

Moreover, a cylindrical rod 16 provided with a thread 16a extends along the axis of the orifice 19 starting from the opposite region of the body 10, situated essentially at the transition between its circular contour and straight contour parts.

In addition, the member 20, which has substantially the same external contour as in the case of the first embodiment, is solid, except for a central bore 28 which opens out on its rear face and in which there is formed an internal thread 28a complementary to the thread 16a formed on the protruding rod 16 of the body.

It will be observed here that the helical pitch of the thread 16a and of the associated internal thread 28a is chosen substantially or exactly equal to the helical pitch of the thread 22 which is still present on the outer surface of the member 20.

A frustoconical part 27 is provided around the mouth of the bore 28.

It will be observed, finally, that the member 20 has, on its front face, a screwing arrangement which in this case consists of a projecting head 26, for example of hexagonal cross-section.

The implant according to this second embodiment is used essentially in the same way as that explained above.

The essential difference lies in the fact that the member 20 is screwed onto the rod 16 in the manner of a nut, the size of the orifice 19 being chosen so as not to form an obstacle to this screwing. In this respect it suffices to choose an orifice 19 with a diameter slightly greater than the overall diameter of the thread 22. It will be noted that the frustoconical part 27 of the member 20 makes it easier to introduce the rear end of the said member into the orifice 19 prior to screwing.

As the pitch of the thread 16a is the same as that of the thread 22, the advance of the member 20 into the body 10, at the same time as the member is being driven in rotation, is such that the thread 22 here once again bites into the vertebral plateaus in the manner of a self-tapping screw.

In particular, it is possible for the upper and lower annular faces 11 and 12 of the body 10 to extend in planes which are slightly oblique in relation to each other, so as to adapt to the shape of the intervertebral space in question. Thus, as will be seen below, the surgeon can be offered bodies 10 having different inclinations in order to adapt to the anatomy of the vertebrae which are to be treated.

In this case, the embodiment in Figures 9 to 15 is advantageous in that the external contour of the member 20 can be given a slightly frustoconical shape in such a way that the amount by which the thread 22 projects relative to the crests of the ribs 11a and 11b remains essentially constant from the front to the rear of the implant, and that as the vertebral faces concerned are substantially parallel to the upper and

lower faces of the body 10, the anchoring afforded via the thread is essentially of the same magnitude from the proximal end to the distal end.

Referring now to Figures 16 to 19, an implant according to a third embodiment of the invention has been shown, which implant comprises a body 10 which, in horizontal section, has the general shape of a U, with a bottom 101, or distal wall, and two essentially parallel lateral walls or branches 102, 103. This body includes upper and lower U-shaped faces, 104 and 104' respectively, on which there are formed bone anchorage teeth 105, 105' respectively, in this case sharp-edged teeth of triangular profile, which fulfil a role analogous to that of the ribs 11b in the preceding embodiments. It will be observed in particular from Figure 17 that the upper and lower faces 104, 104' converge slightly towards one another in the direction towards the region of the bottom 101.

Formed in the distal wall 101 there is a tapped bore 1010 which permits temporary fixing of an instrument, which is not shown and is conventional per se, for fitting the body in the intervertebral space.

The branches 102, 103 define a generally cylindrical internal space, for reasons explained below.

The two lateral branches 102, 103 of the body each include a longitudinal through-slot, 106 and 107 respectively, these slots being intended to permit lateral bone growth.

At the open end of the body 10, remote from its bottom 101, there is a generally circular opening delimited by a reentrant thread 108 provided at the proximal free ends of the two branches 102, 103.

The implant includes an anchorage reinforcement member 20 provided with a hollow core whose outer surface is slightly frustoconical, tapering from its proximal end towards its distal end. A continuous thread 22 is formed on the outer surface of the core 21.

This thread 22, in the form of a helically configured flat band, is able to cooperate with the reentrant thread 108 of the body 10 so as to allow the member 20 to be screwed inside the said body.

As can be seen in particular from Figure 16, the core 21 is made up of three angularly offset longitudinal branches which are separated by longitudinal empty spaces 23.

Each of these branches includes a leading edge (that is to say the front edge in the direction of screwing of the member 20) which is a cutting edge at 21a, in such a way as to constitute a member for scraping the bone material from the overlying and underlying vertebrae. In this way, screwing in the member 20 will allow the internal space of the implant to be filled with bone chips, something which will help the graft to take and which will finally fuse the two vertebrae by means of bone growth.

It will be observed here that the external diameter of the thread 22 is preferably very similar to the internal diameter of the body 10, so that when the member 20 is being screwed in, it is guided inside the body.

Finally, in its proximal part 24 forming a bushing, the member 20 includes an opening which is delimited by a plurality of bosses 24b separated by recessed zones 24c. The bosses 24b, which constitute the start of the branches 21 of the core, have an internal thread on their inner surface.

The implant finally includes a generally cylindrical plug 30 having, on its outer surface, a thread 31 which is able to cooperate with the internal thread defined by the bosses 24b. The rear face 32 of this plug is provided with a recessed socket 32a for a screwing instrument.

The implant, such as it has been described above, is used in the following way:

- the body 10, without the member 20, is put in place between the vertebrae to be treated;

- the member 20, without its plug 30, is filled with bone grafts via its rear opening, and the plug is then put into place in this opening in order to prevent the grafts from escaping;

- the member 20, provided with its plug, is then screwed into the body 10, already in place, with the aid of a screwing instrument which is engaged in the socket 32a; during this operation, the thread 22 of the member 20 anchors in the opposing surfaces of the overlying and underlying vertebrae, possibly cutting off bone chips; in addition, the cutting edges 21a of the three branches 21 of the core of the member 20 attack the vertebrae so as to cut off chips which will complete the filling of the internal space of the member 20; finally, as the core 21 of the member 20 advances, its frustoconical shape ensures compression of some of this bone material against the walls of the vertebrae, in order to assist the grafting.

Figures 20 to 23 illustrate a fourth embodiment of the invention in which the body 10 is similar to that in Figures 16 to 19 and will not be described again in its entirety. It will be observed, however, that in this example only the branch 102 of the body is provided with a through-slot 106, while the other branch does not have one. This type of body is advantageously used when two implants according to the invention are being used in one and the same intervertebral space. In this case, the implants are arranged side by side in such a way that the respective slots of the two bodies are situated on the inside, this being in order to promote fusion with bone grafts placed in the region of the intervertebral space situated between the two implants.

In this case, the anchorage reinforcement member 20 is in the form of a threaded plug which is substantially shorter than the body 10 in the axial direction. This member has a solid cylindrical core 21 provided with a thread 22 which is able to cooperate

with the thread 108 of the body 10, in the same way as before.

The rear face of the member 20 has a recessed socket 24a for a screwing instrument, whilst its front face 25 is in the form of a cone with a rounded apex.

The implant according to this embodiment is intended to be used when the body 10 is being filled relatively densely with bone grafts. In this way, the penetration of the member 20 as it is being screwed in, in addition to reinforcing the anchorage obtained with the aid of the thread 22, compresses the bone grafts situated in the body 10, so as to stress these bone grafts in particular in the direction of the overlying and underlying vertebral plateaus and to improve the fusion.

Figures 24 to 27 illustrate a fifth embodiment of the invention. The body 10 of the implant differs from that of the third and fourth embodiments essentially in that the bottom part 101 has a cylindrical through-opening 101a arranged on the axis of the body, and in that the entry opening situated opposite the bottom 101 does not have the thread 108 of the preceding embodiments.

Here, the anchorage reinforcement member 20 is in the form of a screw which has a wide thread and which, at its front end, has a shaft-like extension made up of two essentially semicylindrical axial lugs 29a, 29b which, at their free ends, have an added thickness, 291a, 291b respectively.

These two lugs have an external diameter which is slightly smaller than the diameter of the opening 101a of the body 10, and they are thinner so that their elastic deformability allows the member 20 to be snapped into the body 10 before it is fitted by the surgeon, the said member 20 thus being immobilized against any translation, but being free in rotation and being guided, on the one hand, by the opening 101a and, on the other hand, by the inner faces of the two branches 102, 103 of the body 10.

Another important feature of this embodiment is that the member 20 is delimited by two flats 201, 201', respectively, which confer upon the member, in its angular position as illustrated in Figure 24, a thickness which is substantially equal to the thickness of the body 10, all along the length of the latter.

It will also be observed that at the transition between the thread 22 (of square cross-section) and the flats 201, 201', the threads each form a sharp angle 22a.

Furthermore, as in some of the preceding embodiments, the proximal part 24 of the member 20 is provided with a recessed socket 24a for a screwing instrument.

The surgeon fits the implant in place in the following way:

- the complete implant, that is to say the body 10 enclosing the member 20 which has first been clipped in, and which has been given the angular orientation in Figure 24, is engaged by impaction into the inter-vertebral space, this operation being made easier by the fact that the member 20 does not protrude beyond the limits of the body 10;

- the member 20 is then turned about its axis with the aid of an appropriate instrument engaged in the socket 24a, so that the sharp edges of the threads 22 attack the bone material of the overlying and underlying vertebral plateaus, in this way tearing off bone chips that will fill the free spaces existing between the body 10 and the member 20, so as to contribute to the bone fusion.

Because the member 20 is immobilized against any translation relative to the body 10, and cannot therefore be screwed into the latter or into the vertebral plateaus, the threads 22 are advantageously given a wide helical pitch so that the screwing action favours a reciprocal sliding of the threads 22 relative to the vertebral plateaus, without inducing an axial

force sufficient to displace the implant in this direction.

Referring now to Figures 28 to 32, a description will be given of a first variant of the third embodiment of the invention which was described above with reference to Figures 16 to 19. In the description which follows, those elements already described with reference to Figures 16 to 19 will not be discussed again, but only the essential differences brought forth by the variant.

According to this variant, the body 1 [sic] is made wider and is designed to receive two anchorage reinforcement members, 20a and 20b respectively. To this end, the body 10 is widened and has two lateral branches 102 and 103 as well as an intermediate middle branch 109 extending between the branches 102 and 103.

The branches 102 and 109 define a first seat for the member 20a, while the branches 103 and 109 define a second seat for the member 20b, the axes of these two seats here being mutually parallel, but being able, if appropriate, to adopt a certain inclination. These two seats preferably have the same configuration as the single seat of the third embodiment, and the members 20a and 20b are preferably similar to the member 20 of this same embodiment.

Likewise, the body 10 is provided with bone anchorage teeth 105, 105'.

It will be observed here, as shown particularly in Figures 30 and 31, that the upper and lower faces 104 and 104' of the body 10 have a dual inclination, one corresponding to these faces coming closer together in the direction towards the bottom of the seats, and the other corresponding to these faces coming closer together in a lateral direction (from right to left in Figure 30), but the opposite can be obtained simply by turning the body 10 around.

This dual inclination allows the body 10 to be implanted at a slant while re-establishing the lumbar lordosis in the sagittal plane.

Furthermore, the increased width of the implant ensures a more stable support between the two vertebral plateaus, whilst the presence of two anchorage reinforcement members 20a and 20b reinforces the resistance to slipping relative to these plateaus.

Of course, this variant of the invention can be applied to all the other implants described in the present document, with a simple adaptation of the body 10, within the ability of a person skilled in the art, being all that is needed.

Referring now to Figures 33 to 44, a description will be given of another variant of the implant which was described with reference to Figures 16 to 19.

According to this variant, the outer body 10 of the implant comprises, in the same way as before, a general U shape with two lateral branches 102 and 103 connected via a distal end wall 101, with rounded transitions.

To increase the width of the implant, and hence to improve its stability, the lateral branches 102 and 103 have, in the lateral direction, a thickness which is substantially greater than that of the branches 102 and 103 described with reference to Figures 16 to 19.

This thickness is preferably chosen in such a way as to give the overall width of the implant a value which is, for example, equal to about 1.5 to 2.5 times the diameter of the anchorage reinforcement member 20.

In addition, to further improve the bone fusion between the overlying and underlying vertebral plateaus, oblong through-openings 110 and 111 are provided which extend, for example, vertically between the upper face 104 and the lower face 104' of the body, in such a way that the lateral branches 102 and 103 each have a double wall. Also formed in each of these walls there is a generally horizontal oblong opening 106, 106', and 107, 107', respectively, which allow the internal space of the body 10 to open out laterally to the outside of the body, by passing through the two

double walls and the through-openings 110, 111, respectively.

It will also be observed, as shown in Figures 43 and 44, that the upper and lower faces 104 and 104' of the body have a dual inclination relative to each other, on the one hand in the lateral direction, and on the other hand from the proximal end towards the distal end.

The anchorage reinforcement member 20 has a construction similar to that which was described with reference to Figures 16 to 19. It essentially comprises an internal fork having two branches 21, to which a helical band 22 forming a bone anchorage thread is attached, the parts 21 and 22 preferably being made in one piece.

The thread 22 is in this case preferably a self-tapping thread, which makes it possible to screw directly into the overlying and underlying vertebral plateaus without having to form a tapping in these vertebral plateaus prior to fitting. To this end, the thread 22 has, in its distal end region, a radial section 22b in the form of an outwardly turned point, and this section varies progressively, for example by about a fraction of a turn, up to a rectangular radial section 22c. In addition, the diameter of the thread 22 increases progressively from its distal end up to the said part of rectangular section, which is here of constant diameter.

It will also be observed that the outer faces of the branches 21 have a tapered form, the diameter decreasing from the proximal end towards the distal end, for reasons which are explained below.

The two branches are joined at the area of a bushing 24 which is in the form of a cylindrical ring, formed preferably in one piece with the said branches.

A plug 30 having a series of flexible locking tabs 33, in this case two pairs of tabs, can be mounted in this bushing 24 by being clipped in elastically from the outside, which tabs engage in the central opening

of the bushing 24, and the ends of which tabs, in the form of teeth 33a, can catch onto the internal edge of the bushing 24.

The member 20 and its plug 30 are made integral in terms of rotation by means of the fact that each pair of tabs 33 tightly encloses the start of a respective branch 21 of the fork.

The plug 30 also has a tapped bore 34 arranged centrally and able to receive the threaded rod-shaped end of an instrument, which is known per se and is not shown, for fitting the member 20.

It will also be observed in Figures 40 and 44 that two diametrically opposite notches 35, formed on either side of the tapped bore 34, permit angular indexing of the abovementioned instrument, in this case equipped with complementary arrangements, relative to the plug 30 and, thus, to the whole of the anchorage reinforcement member 20.

It will then be observed, in particular in Figure 44, that the thread 108 permitting screwing cooperation between the outer body 10 and the member 20 is provided only on one of the lateral branches 102 of the body, in the form of a reentrant flange ending in a generally rectilinear edge 108a.

Finally, it will be observed, in particular in Figures 33, 38 and 40, that the end of the thread 22 on the proximal side is deformed, as indicated at 22d, this deformation being obtained in the direction of the adjacent thread turn, that is to say towards the distal end.

This deformation makes it possible to give the thread 22 an immobilizing function against reverse rotation, and thus to prevent any risk of the anchorage reinforcement member 20 coming loose from the body 10 after fitting, but before bone fusion.

The implant described above with reference to Figures 33 to 44 is fitted in place using the following successive steps:

- first, the openings 110 and 111 of the body 10 are filled with material promoting bone growth, such as bone grafts;

- the body is then inserted into the intervertebral space, if necessary after distraction;

- the anchorage reinforcement member 20 is filled with a material promoting bone growth, and this member 20 is then closed at its proximal end by the plug 30 being clipped in;

- by means of screwing, the said member is engaged in the already fitted body; it should be noted here that the tapering shape of the two branches 21 of the fork of the member 20 makes it possible, as the member 20 advances, to compress the bone growth material and thus to ensure good contact on the one hand with the overlying and underlying vertebral plateaus and on the other hand with the bone growth material placed beforehand in the openings 110 and 111, via the openings 108 and 109.

The implants according to the invention are of course made of a biocompatible material of suitable strength, such as a titanium alloy or stainless steel.

The surgeon is advantageously offered implants according to the invention in the form of a set of implants of different shapes and dimensions, and this makes it possible to choose the implant, and in particular the body 10, best suited to the anatomy of the implantation site.

In particular, implants can be provided:

- in which the bodies 10 have different heights, with, in this case, anchorage reinforcement members 20 whose diameters can vary in order to adapt to these different heights,

- in which the bodies have different widths; thus, in the particular case of the third embodiment, it is possible to provide a range of implants whose widths vary progressively between a minimum width (case in Figures 16 to 19) and a maximum width (for example as represented in Figures 33 to 44), by varying the

thickness, in the lateral direction, of the lateral branches 102 and 103 of the body, while at the same time maintaining the same size of internal space and also being able to use the same member 20 in all cases; these lateral branches 102, 103 advantageously vary from a single wall (Figures 16 to 19) to a double wall (Figures 33 to 44) once the thickness of the said branches 102, 103 has become sufficient to allow the vertical through-openings 110 and 111 to be made;

- in which the bodies have upper and lower faces of different mutual inclinations, both from the front towards the rear and also laterally, with members 20 of identical or different diameters;

- in which the bodies 10 and/or the anchorage reinforcement members 20 have different lengths;

- in which the anchorage reinforcement members have different anchorage projections, and in particular of greater or lesser depth and greater or lesser spacing, depending on the mechanical characteristics encountered in the vertebral plateaus; etc.

Of course, the present invention is in no way limited to the embodiments described above and illustrated in the drawings, and the person skilled in the art will be able to vary or modify them in accordance with the spirit of the invention, and in particular will be able to combine the particular features of the various embodiments described.

Furthermore, the bone anchorage projections such as have been described above can consist of any means permitting mechanical anchorage and/or of bone connection with the overlying and underlying vertebral plateaus. In particular, this can be a porous coating or hydroxyapatite.

The claims defining the invention are as follows:

1. An implant for surgery of the spine, comprising an essentially hollow body which can be inserted into an intervertebral space, the said body having a pair of lateral walls enclosing an internal space exposed to the overlying and underlying vertebrae which define the said intervertebral space, the said implant additionally comprising an anchorage reinforcement member having, on its external surface projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said member being able to be driven in rotation in the internal space of the body, and in which the said projections for bone anchorage comprise a screw thread, and at least one of the lateral walls of the body has a reentrant part which is able to cooperate with the said thread.

2. An implant according to claim 1, in which the said reentrant part is provided only on one of the walls and constitutes the only part of the body cooperating, by screwing, with the screw thread.

3. An implant according to claim 2, in which the said reentrant part has an essentially rectilinear free end edge.

4. An implant according to claim 1, in which the said hollow body has upper and lower surfaces which are inclined in relation to one another with a distance between them which decreases from the proximal end towards the distal end of the body.

5. An implant according to claim 1, in which the said hollow body has upper and lower surfaces which are inclined in relation to one another, with a distance between them which decreases from a first lateral side of the body towards the opposite lateral side.

6. An implant according to claim 1, in which the said lateral walls have through-openings permitting bone to grow through them, and extending between an upper and a lower faces of the body.

7. An implant according to claim 6, in which second through-openings bring the said internal space into communication with the said first through-openings.

8. An implant according to claim 6, in which through-openings are provided which bring the said first through-openings into communication with the outer sides of the body.

9. An implant according to claim 1, in which the said hollow body has a distal end wall connecting the said lateral walls, the said distal end wall being rounded to facilitate insertion of the said hollow body into the said intervertebral space.

10. An implant according to claim 1, in which the said projections for bone anchorage comprise a self-tapping screw thread, having a radial cross-section which changes progressively from an essentially triangular radial cross-section to a generally square radial cross-section starting from the distal end of the said thread.

11. An implant according to claim 1, in which the said projections for bone anchorage comprise a screw thread in the form of a helical band encircling an internal space of the said anchorage reinforcement member, connected to a fork extending inside the said band in an axial direction of the said member, and in which the said fork comprises branches having a frustoconical external surface, the diameter of which decreases from the proximal end towards the distal end of the member.

12. An implant according to claim 1, in which the said member is oriented obliquely in relation to a plane of the body corresponding to the sagittal plane.

13. An implant according to claim 12, in which the anchorage reinforcement member is oriented at approximately 45° in relation to a plane of the body corresponding to the sagittal plane.

14. An implant for surgery of the spine, comprising an essentially hollow body which can be inserted into an intervertebral space, the said body having a pair of lateral walls enclosing an internal space exposed to the overlying and underlying vertebrae which define the said intervertebral space, the said implant additionally comprising an anchorage reinforcement member having, on its external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said member being able to be driven in rotation in the internal space of the body, in which the said projections for bone anchorage comprise a screw thread, and in which the said member has means for immobilizing the latter in the said hollow body against reverse rotation.

15. An implant according to claim 14, in which the said projections for bone anchorage comprise a screw thread, and the said immobolizing means comprise a deformed part of the said thread in the region of its proximal end.

16. An implant for surgery of the spine, comprising an essentially hollow body which can be inserted into an intervertebral space, the said body having a group of generally parallel walls defining at least two internal spaces situated side by side and exposed to the overlying and underlying vertebrae which define the said intervertebral space, the said implant additionally comprising at least two anchorage reinforcement members having, on their external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, the said members being able to be driven in rotation in respective internal spaces of the said body.

17. An implant according to claim 16, in which the said members are identical.

18. A method for positioning, in an intervertebral space of a human vertebral column, an implant comprising an essentially hollow body having a pair of lateral walls enclosing an internal space, and an anchorage reinforcement member having, on its external surface, projections for bone anchorage which are inscribed within a diameter greater than the overall height of the body, and able to be driven in rotation in the internal space of the body, the said method comprising the following steps:

- selecting a hollow body which is adapted to the configuration of the said intervertebral space,
- filling the said selected hollow body with a substance which promotes bone growth,
- pushing the said hollow body into the said intervertebral space in such a way that the internal space thereof is exposed to the overlying and underlying vertebrae which define the said intervertebral space, and
- inserting the said anchorage reinforcement member into the said hollow body in such a way that the said projections for bone anchorage anchor in the said overlying and underlying vertebrae.

19. A method according to claim 18, for positioning an implant whose body has lateral walls provided with through-openings extending between an upper and a lower faces of the said body, the method additionally comprising, before the step of pushing the said hollow body into the said intervertebral space, a step in which the said through-openings are filled with a substance which promotes bone growth.

20. An implant for surgery of the spine substantially as hereinbefore described with reference to the accompanying drawings.

21. A method for positioning an implant including the steps substantially as hereinbefore described.

Dated: 5 December 2001

FREEHILLS CARTER SMITH BEADLE

Patent Attorneys for the Applicant:

STRYKER FRANCE S.A.

FIG.1

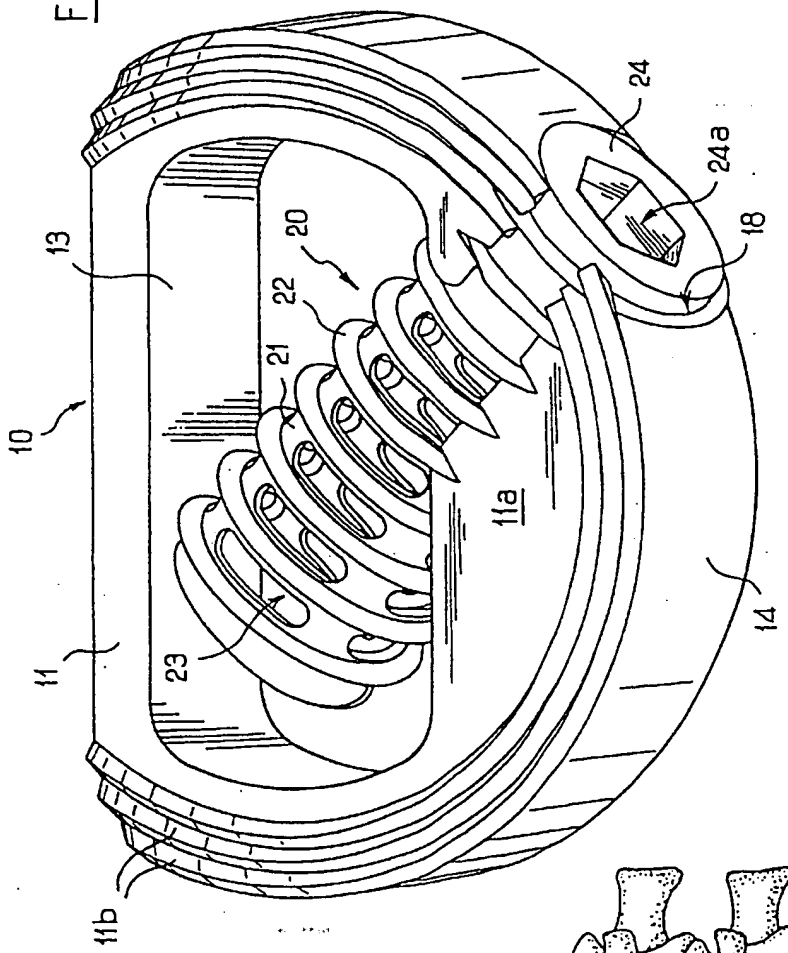
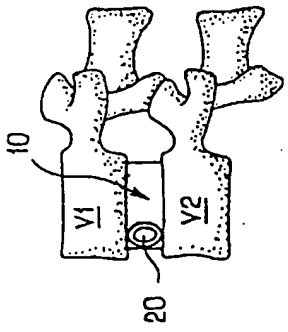


FIG.2



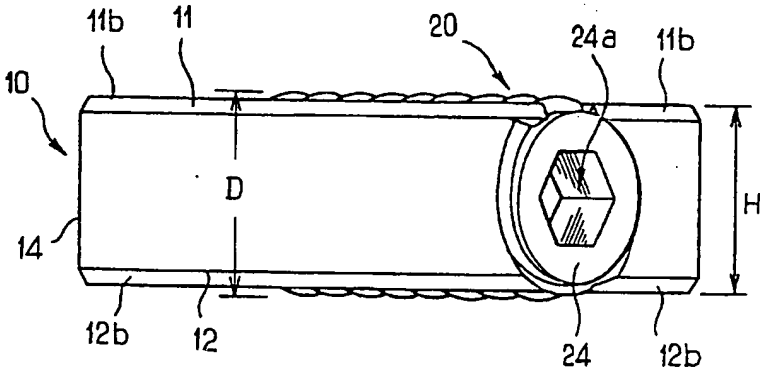
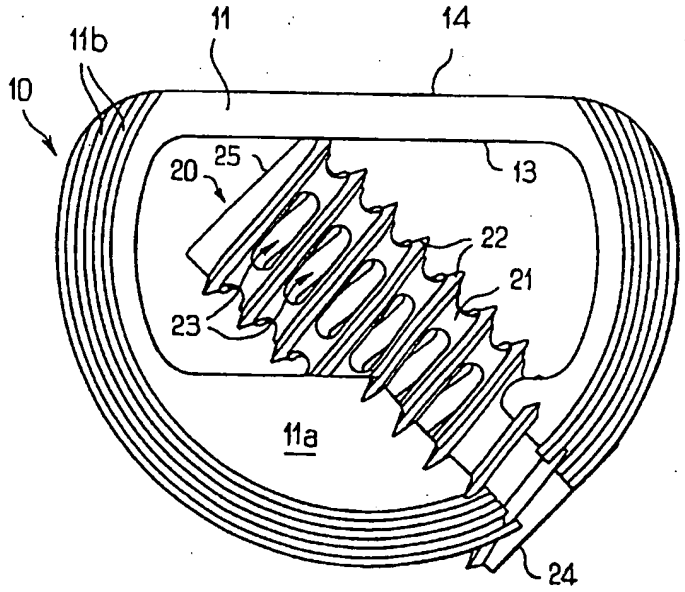

11b
11
20
24a
11b
10
D
H
14
12b
12
24
12b

FIG_3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14
11b
10
25
20
13
22
21
23
11a
24

FIG_4

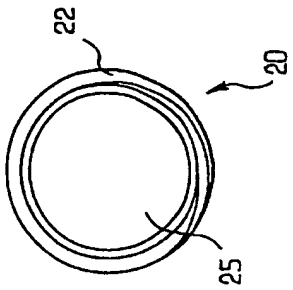


FIG_6

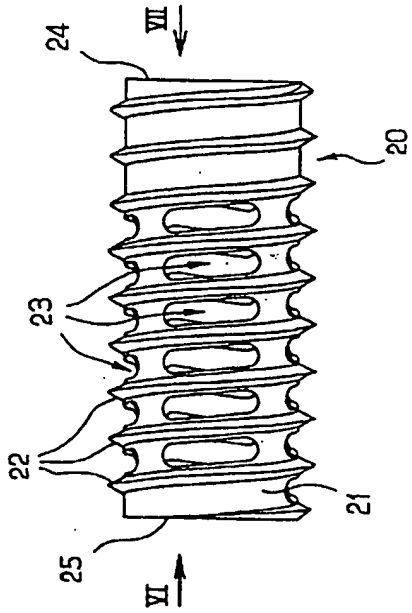


FIG_5

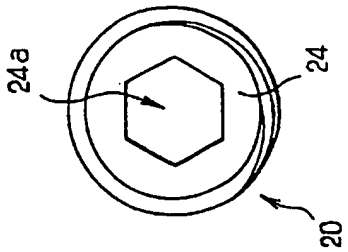


FIG_7

FIG.8

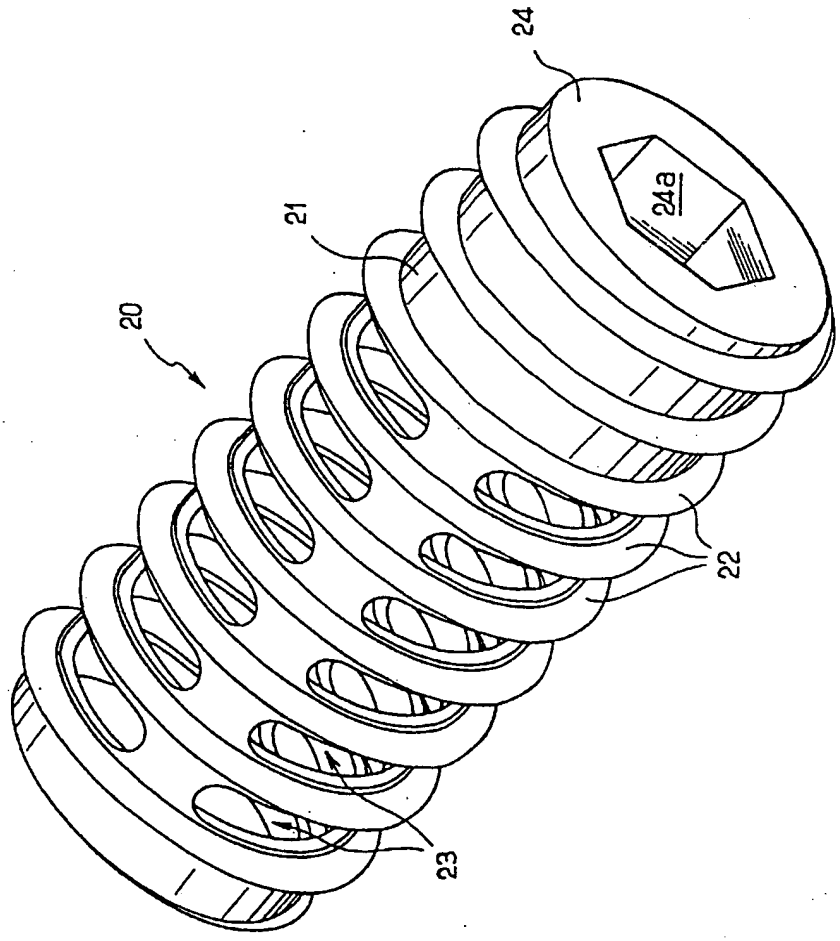
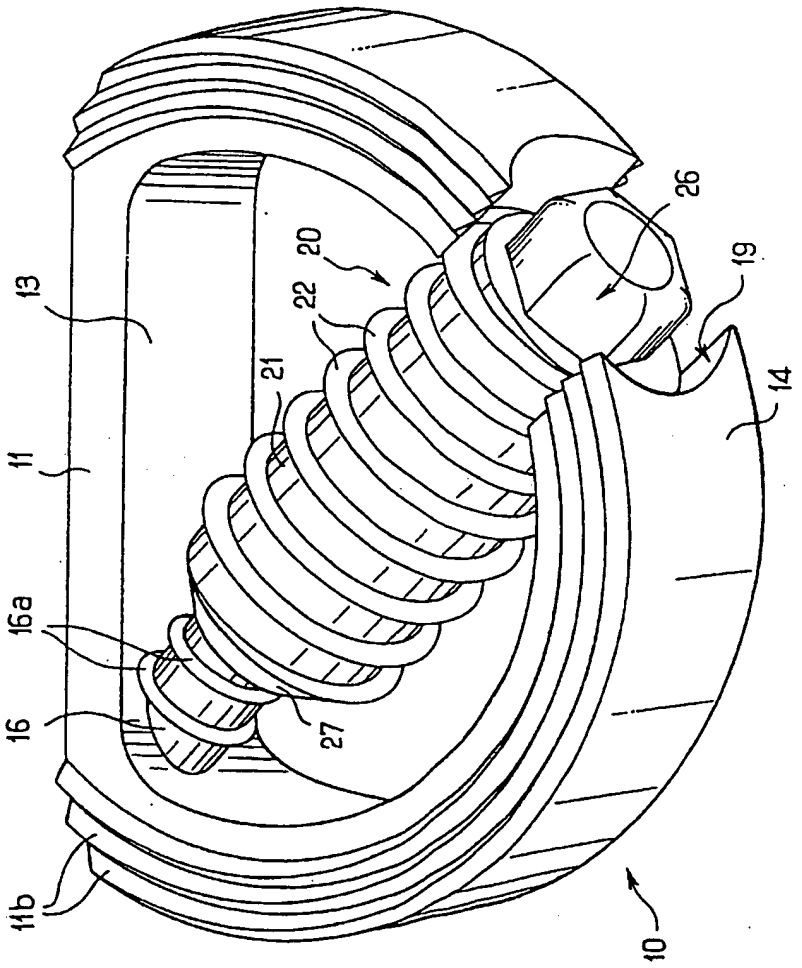


FIG_9



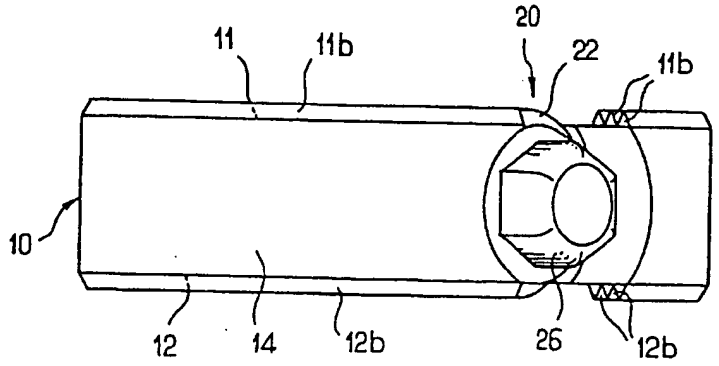

11
11b
20
22
11b
10
12
14
12b
26
12b

FIG_10

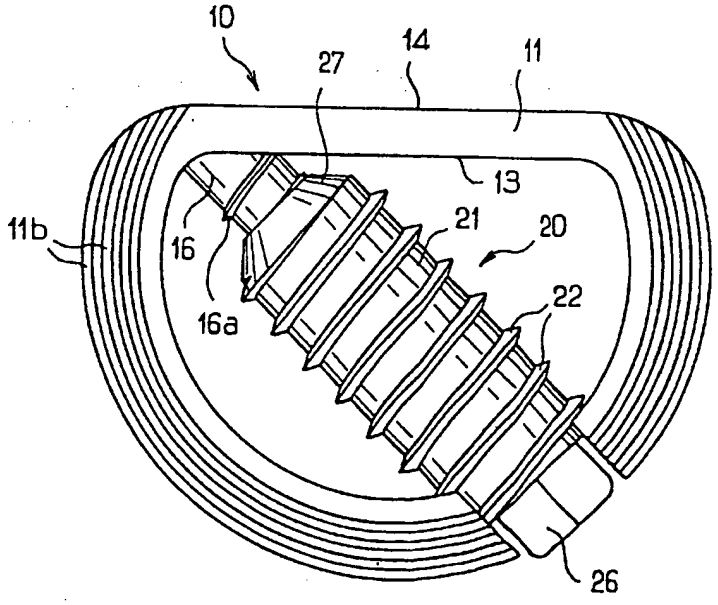

10
27
14
11
13
11b
16
21
20
16a
22
26

FIG_11

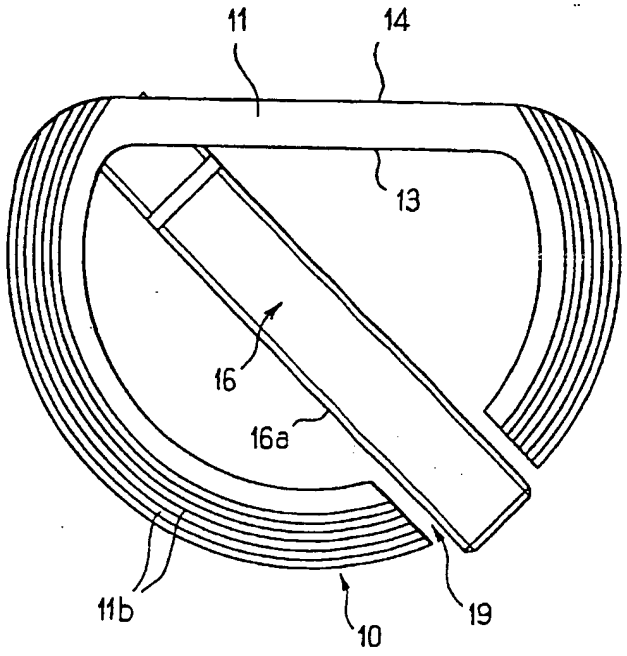


FIG_12

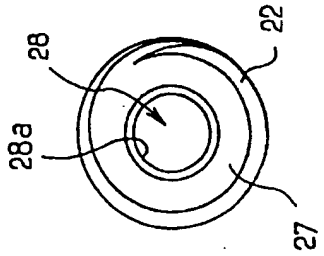


FIG.14

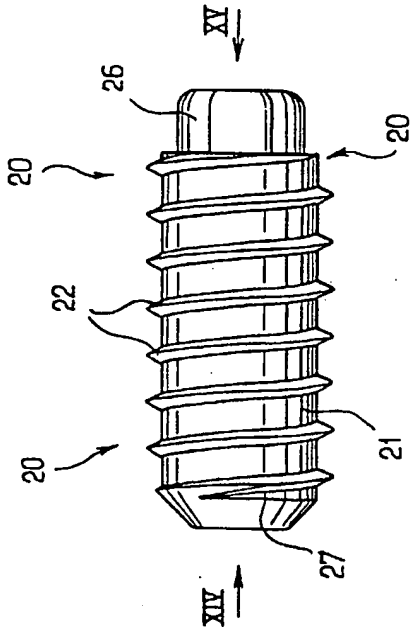


FIG.13

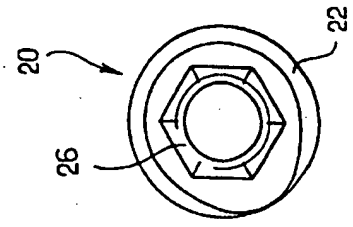


FIG.15

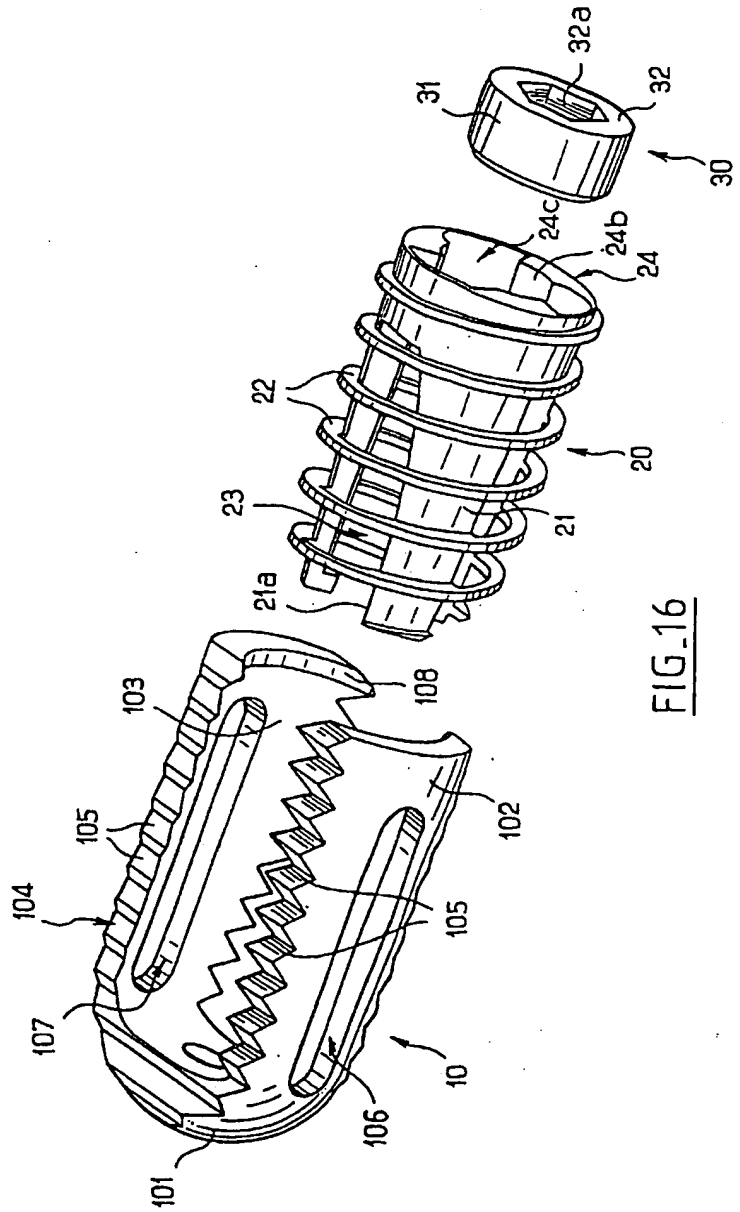

32a
31
32
30
24c
24b
24
22
20
23
21
21a
103
108
102
105
104
105
107
10
106
101

FIG_16

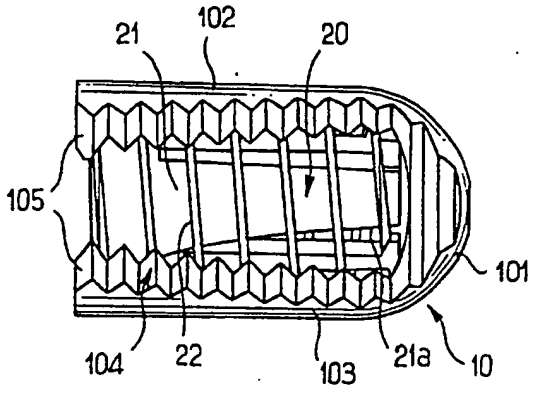


FIG_18

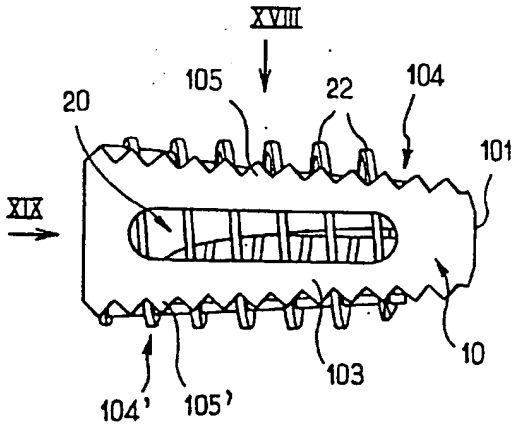


FIG_17

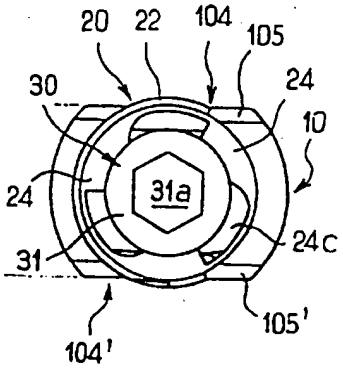


FIG_19

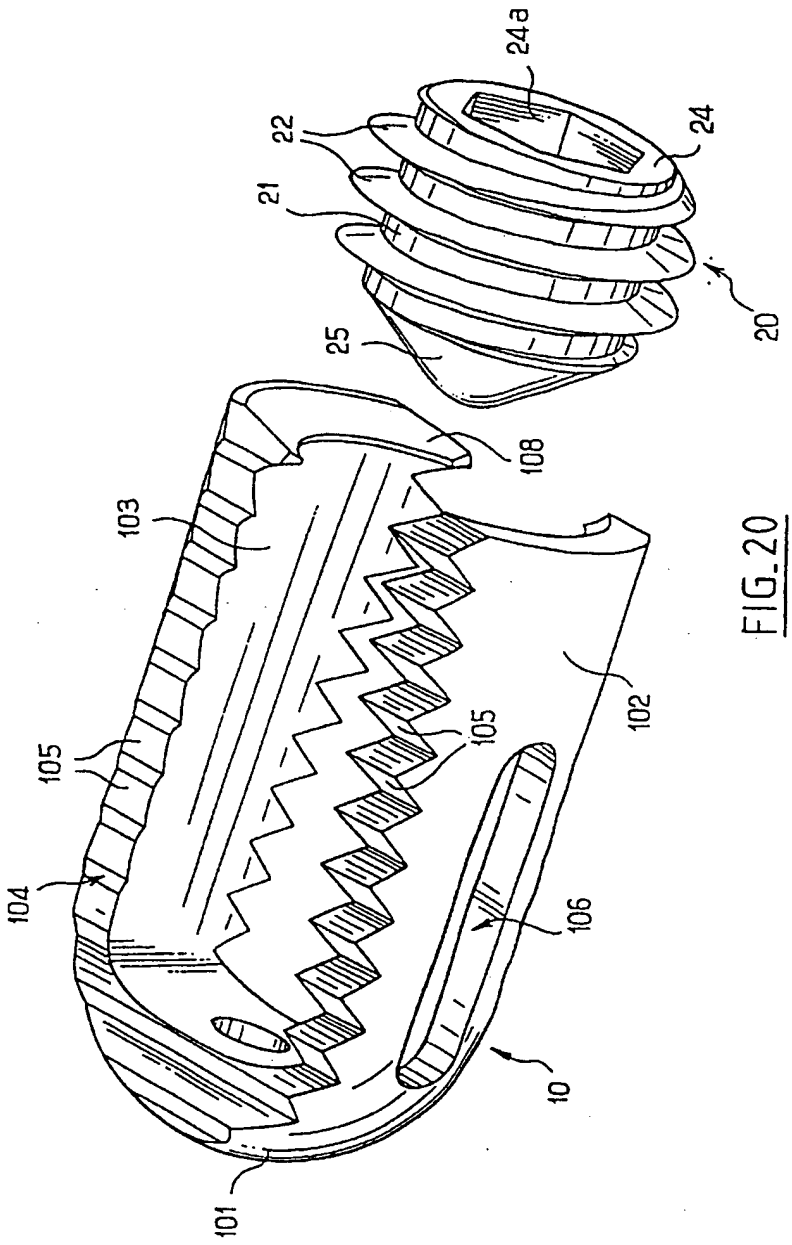


FIG.20

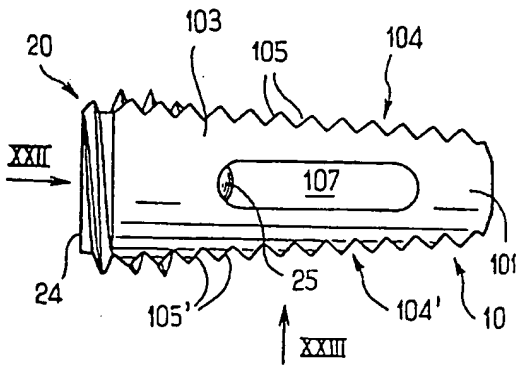


FIG_21

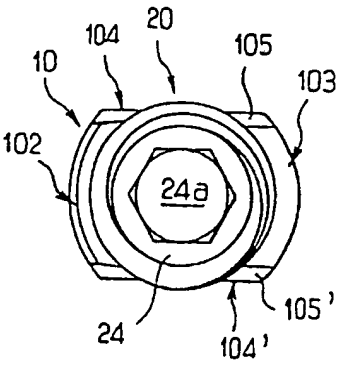


FIG_22

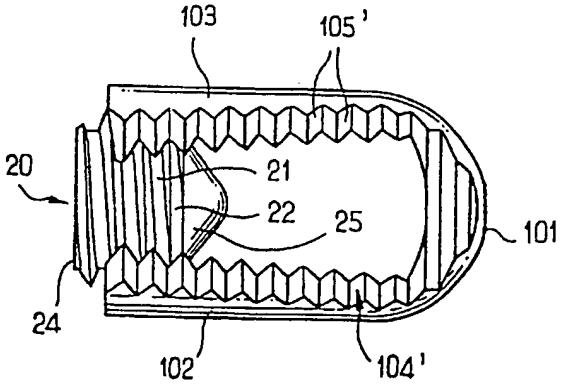


FIG_23

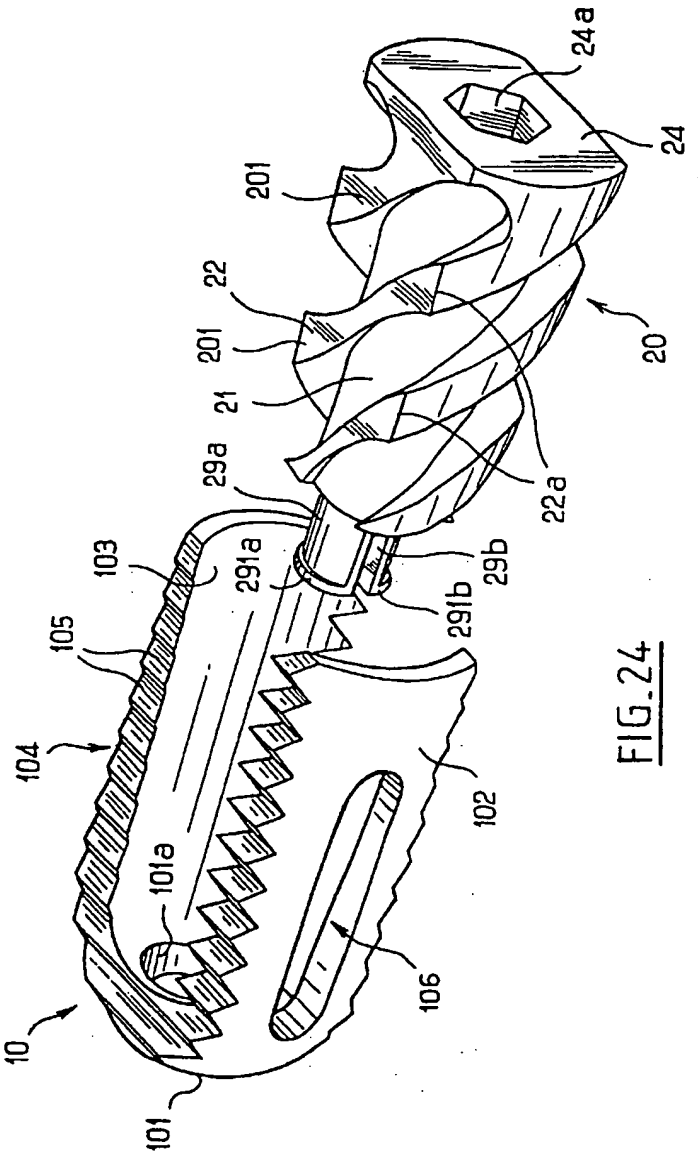

24a
24
201
22
201
21
20
29a
22a
103
291a
29b
291b
105
104
102
101a
106
10
101

FIG.24

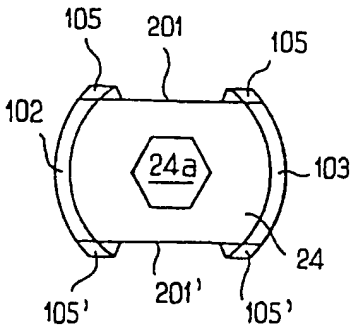


FIG_26

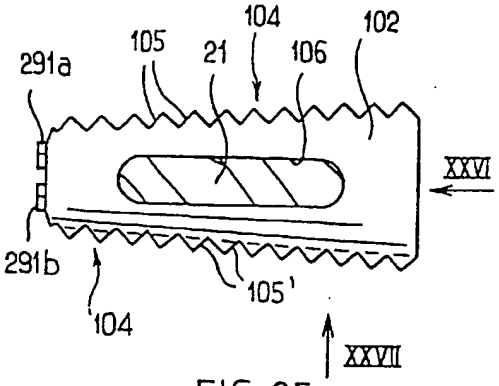


FIG_25

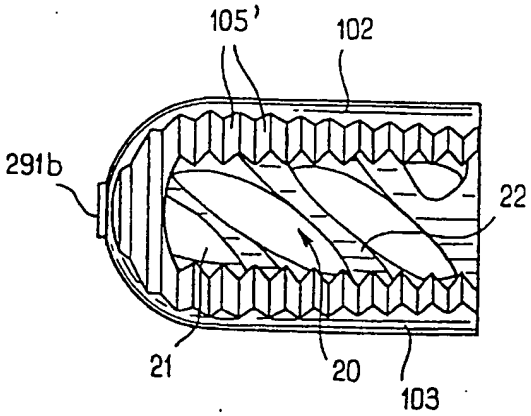


FIG_27

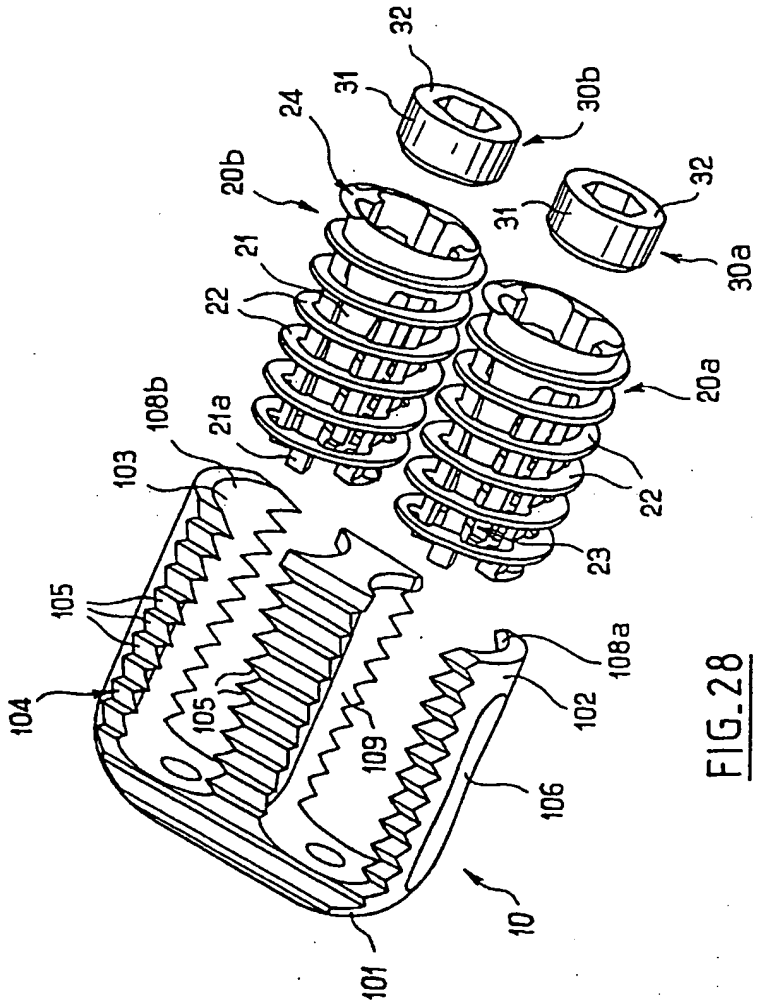

32
31
30b
24
20b
32
31
30a
21
22
20a
108b
21a
103
22
23
105
108a
104
105
102
109
106
10
101

FIG.28

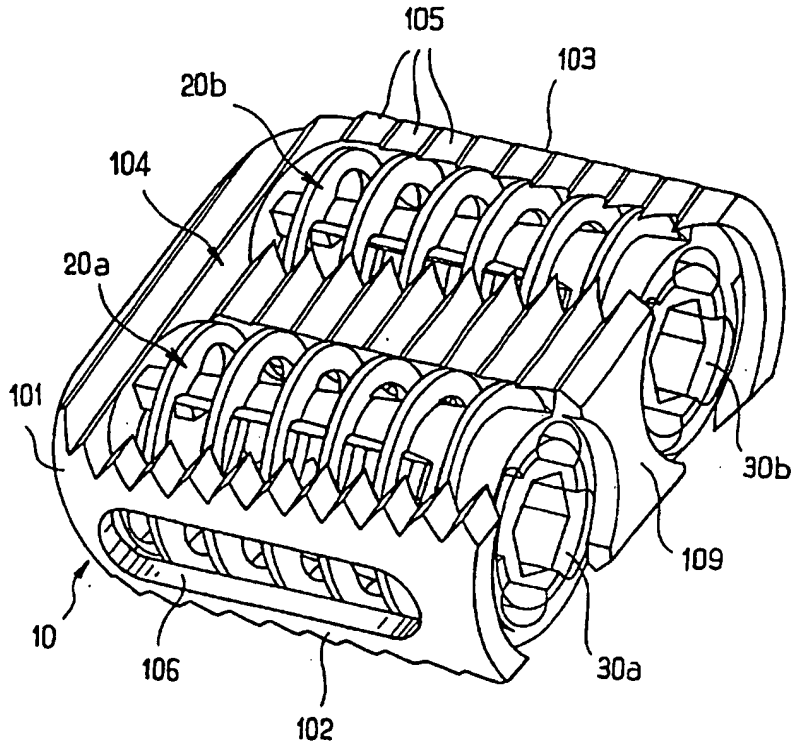


FIG_29

FIG_30

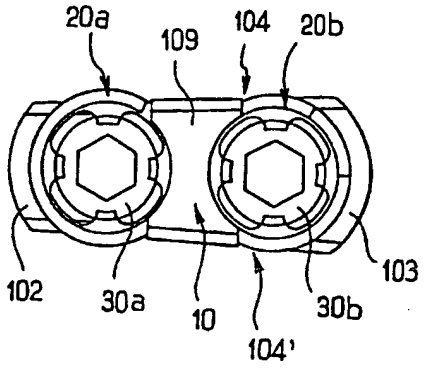


FIG_31

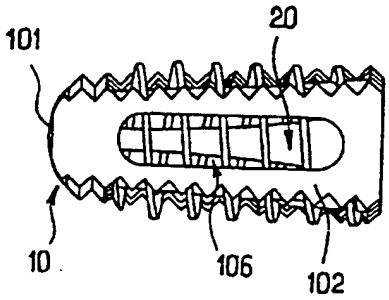
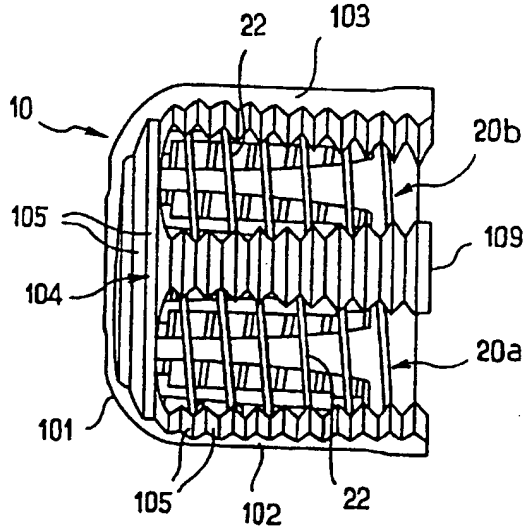


FIG_32



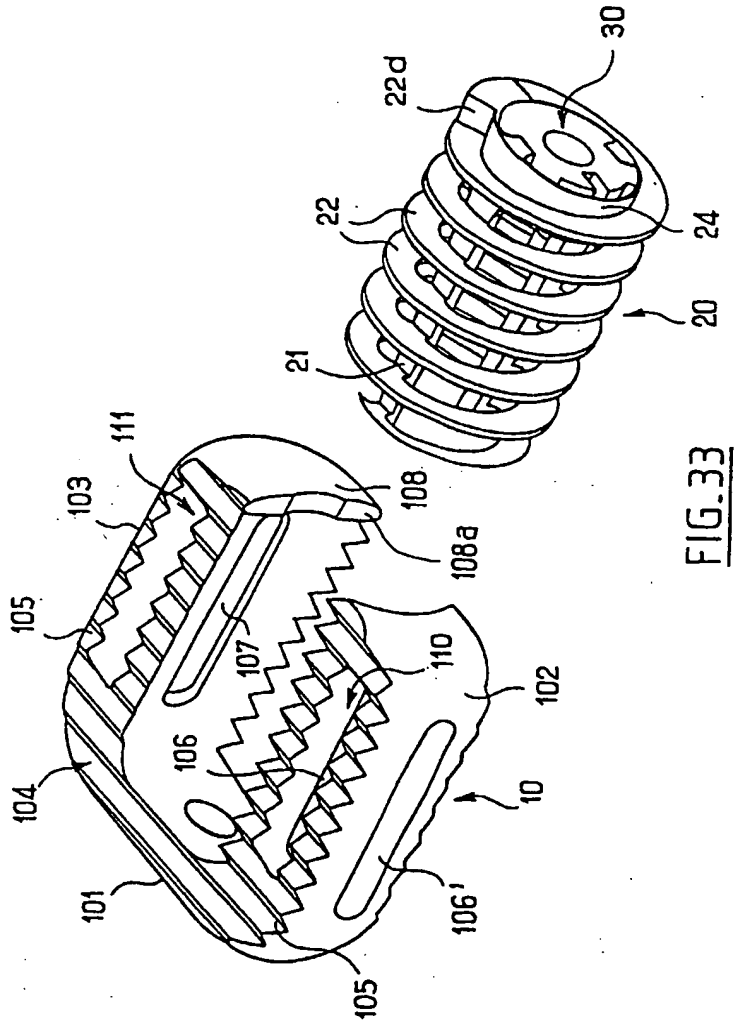

30
22d
22
24
20
21
111
103
108
108a
105
107
110
102
106
104
10
101
106'
105

FIG.33

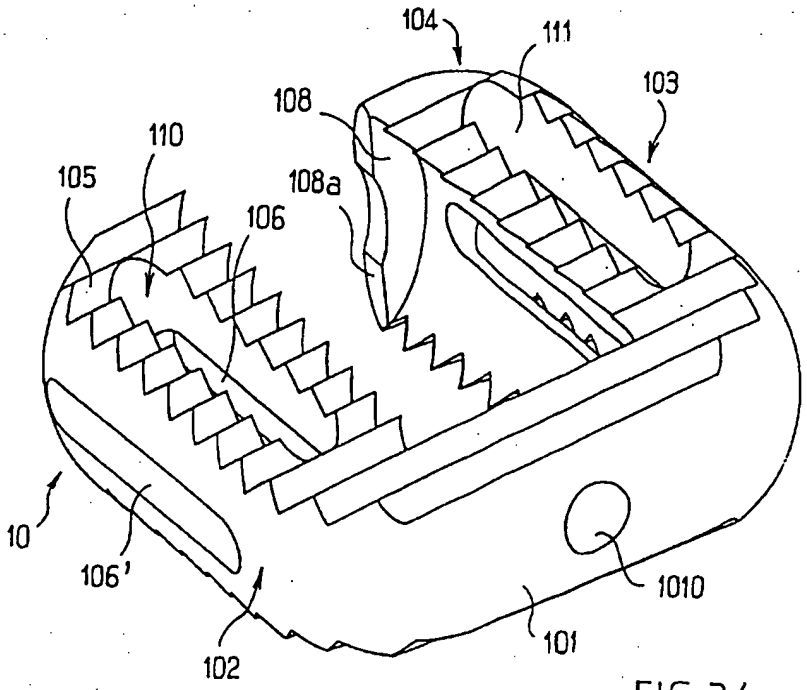

104
111
103
108
110
105
108a
106
10
106'
102
101
1010

FIG. 34

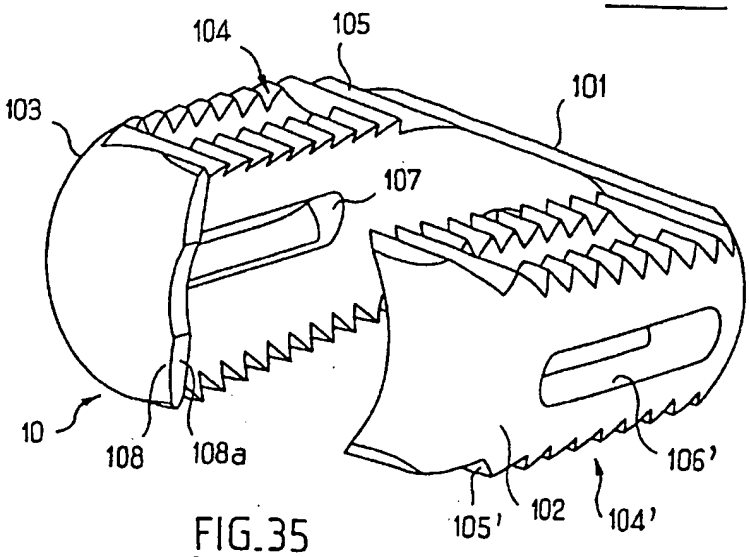

104
105
103
101
107
10
108
108a
106'
105'
102
104'

FIG. 35

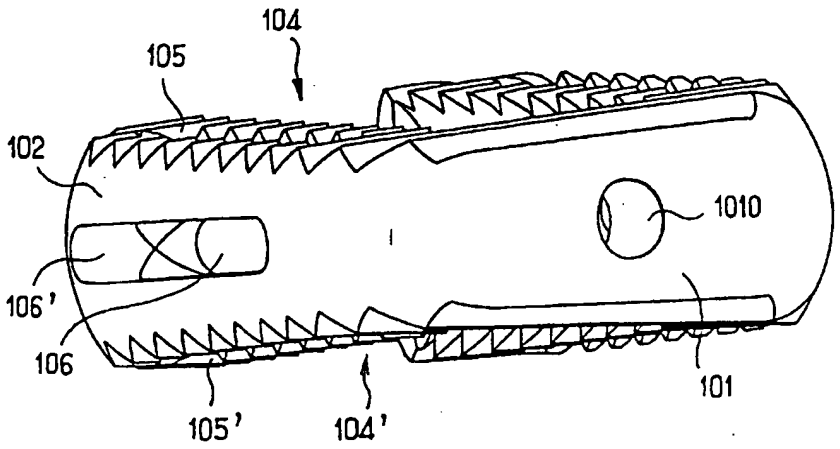


FIG.36

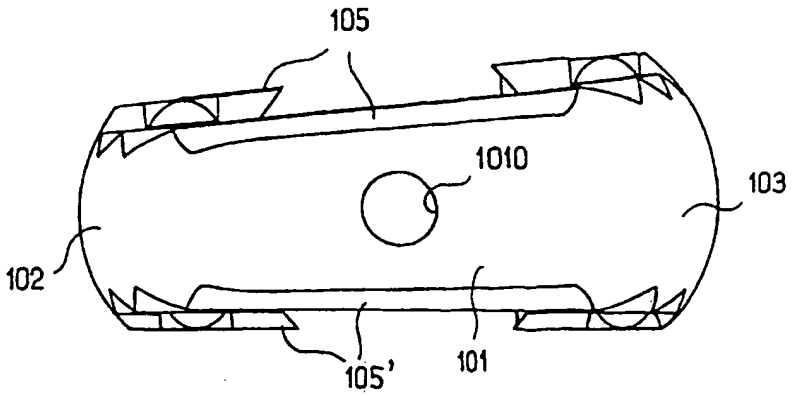


FIG.37

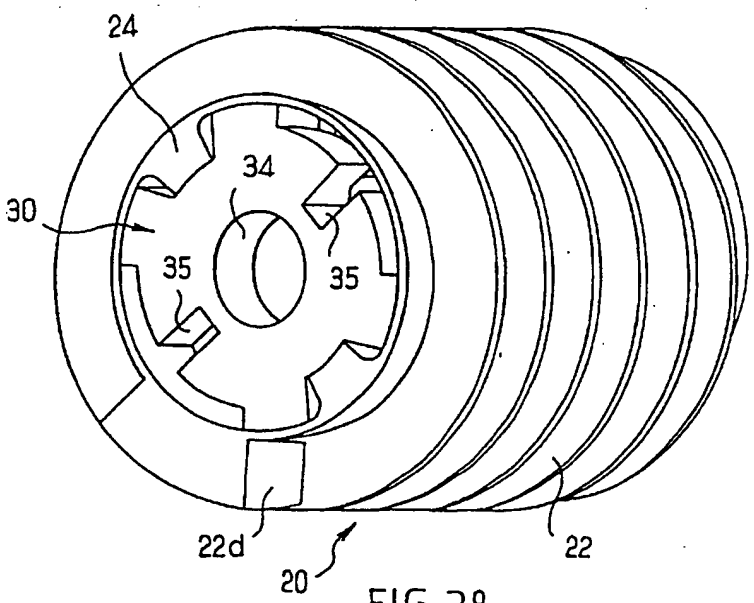


FIG.38

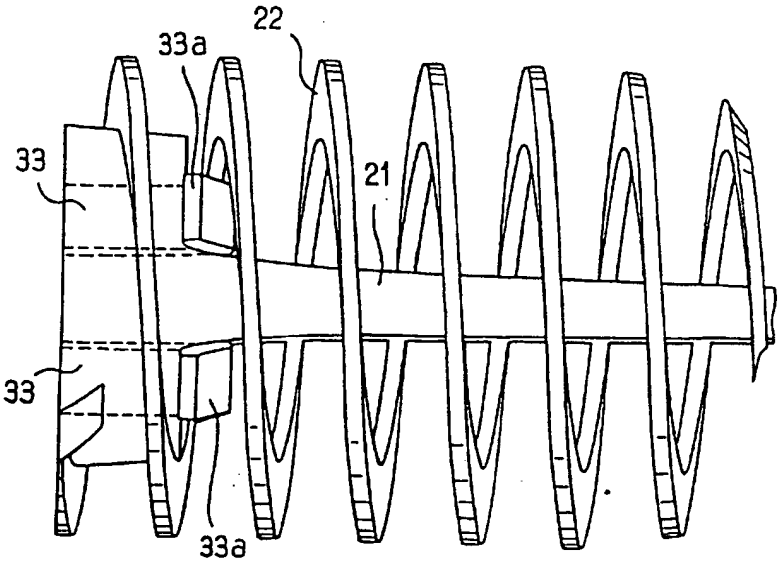


FIG.39

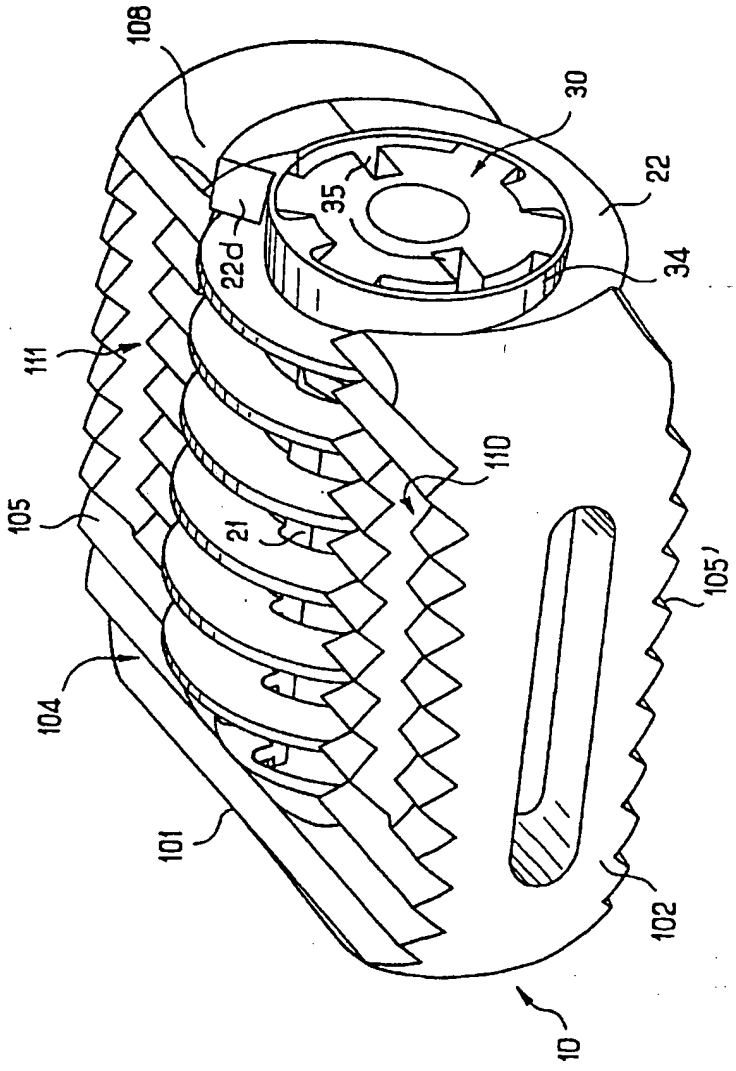


FIG.40

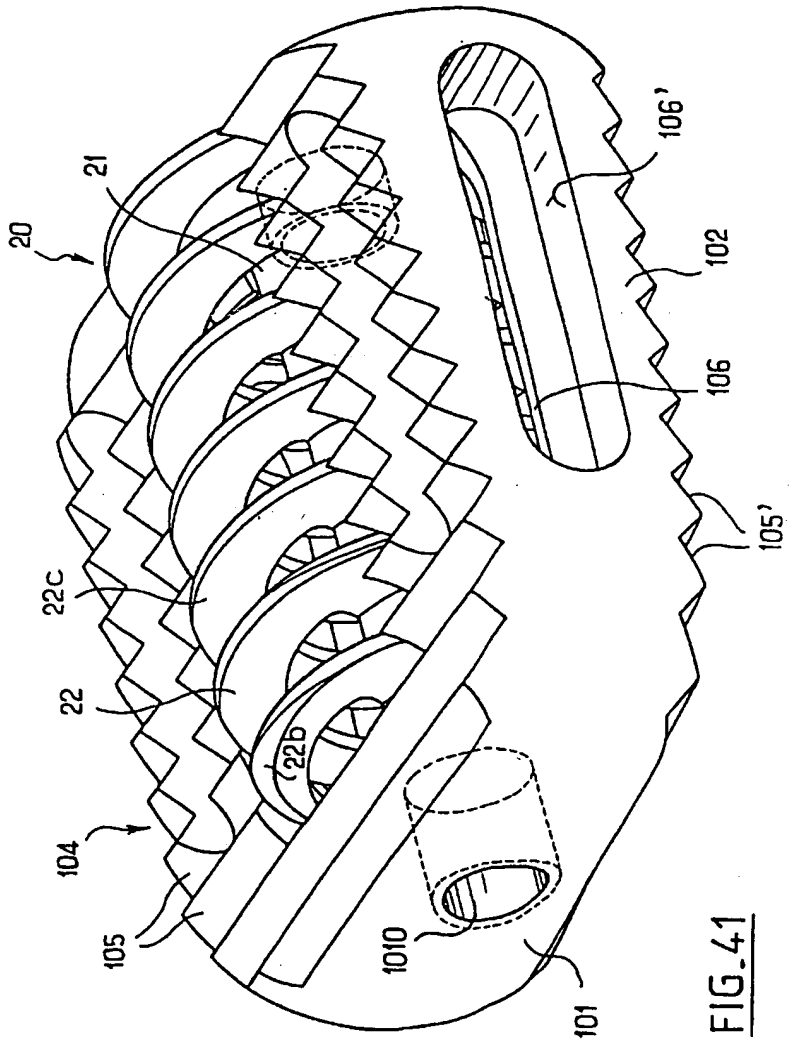


FIG.41

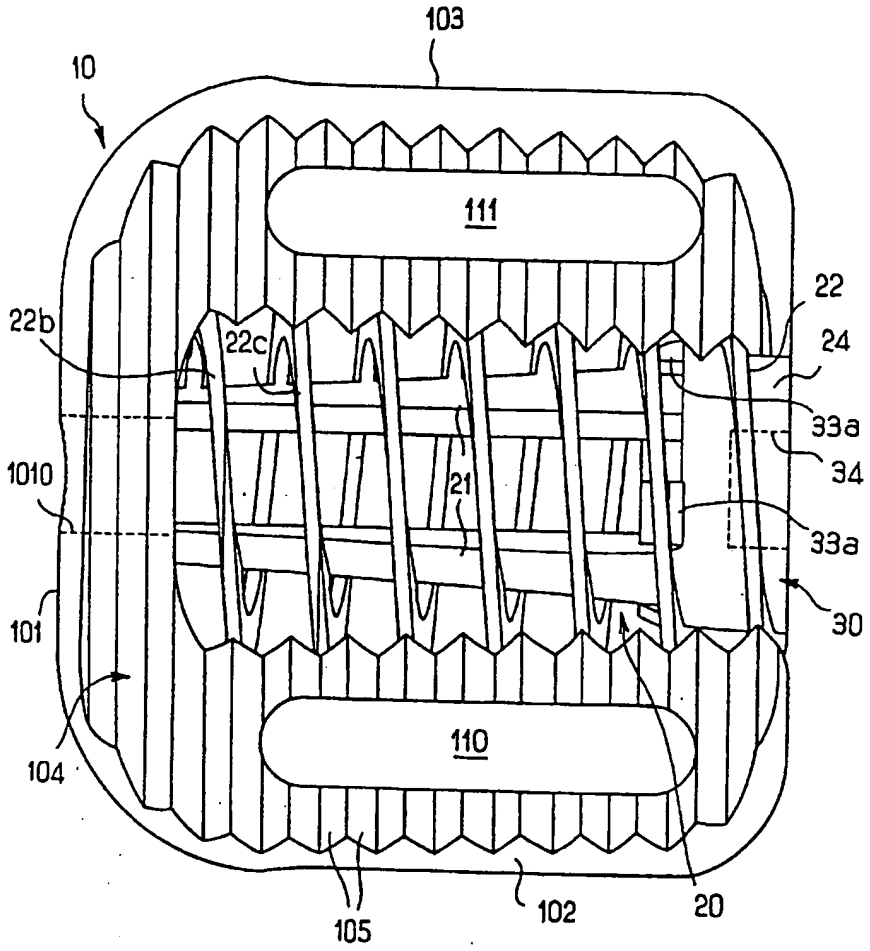

103
10
111
22
22b
22c
24
33a
34
1010
21
33a
30
101
104
110
105
102
20

FIG.42

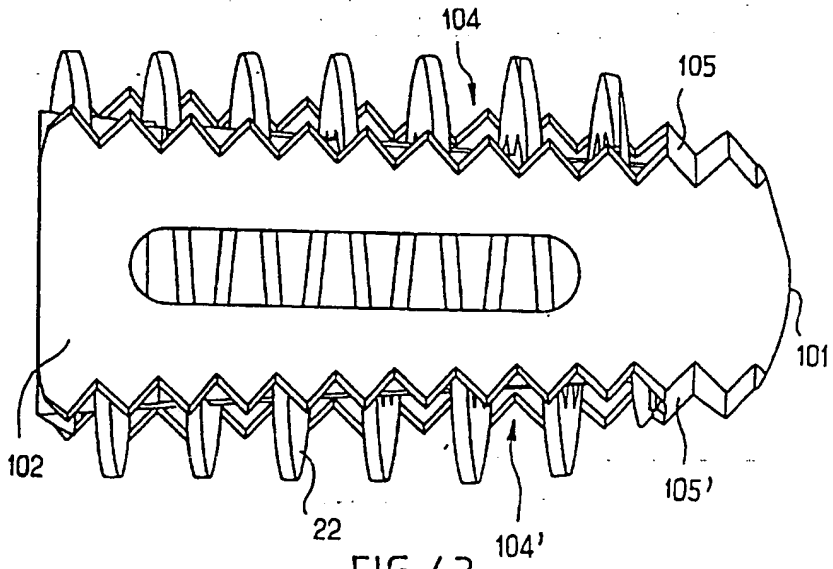

104
105
101
102
105'
22
104'

FIG_43

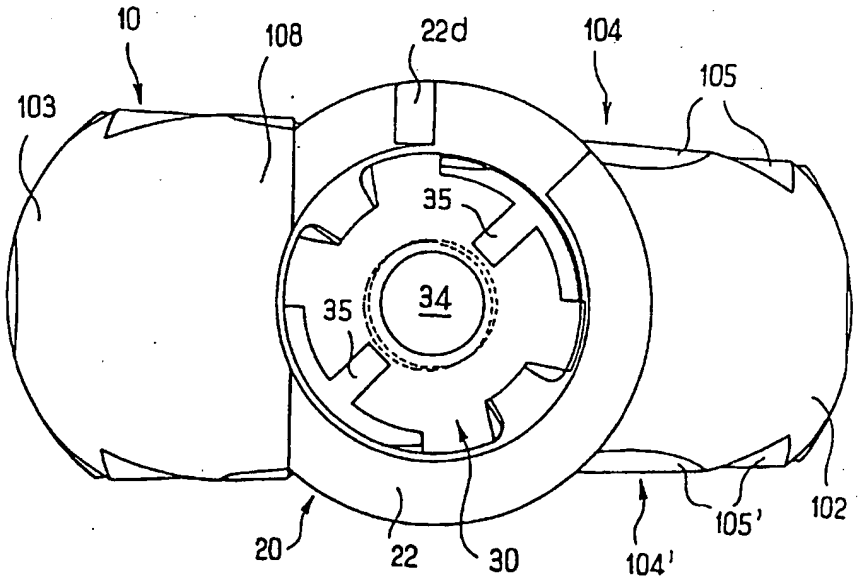

10
108
22d
104
105
103
35
34
35
20
22
30
104'
105'
102

FIG_44